The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

INVESTOR IN PEOPLE

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed P. Mahoney

Dated 6 November 2003

PCT/EPU3/ 1 2 2 3 3

V02 E761193-1 D00524
P01/7700 0.00-0225799.6

Patents Form 1/77

Patents Act 1977
(Rule 16)

THE PATENT OFFICE
– 5 NOV 2002
RECEIPT BY HAND

1/77

The **Patent Office**

Request for grant of a patent
(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
Cardiff Road
Newport
Gwent NP10 8QQ

1. Your reference **1-32748P1/FMI**

2. Patent application number
(The Patent Office will fill in this part) 0225799.6

05 NOV 200

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Novartis Forschungsstiftung,
Zweigniederlassung Friedrich Miescher Institute for Biomedical Research,
Maulbeerstrasse 66, CH-4058 Basel,
Switzerland

Patent ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation **SWITZERLAND**

8206583 001

4. Title of invention **TEL/ETV6-mediated inhibition of cell proliferation**

Novartis Pharmaceuticals UK Ltd
Patents and Trademarks
Wimblehurst Road
HORSHAM
West Sussex
RH12 5AB ADP No 0718522002

B.A. YORKE & CO.
CHARTERED PATENT AGENTS
COOMB HOUSE, 7 ST. JOHN'S ROAD
ISLEWORTH
MIDDLESEX TW7 6NH

1800001

6. If you are declaring priority from one ore more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing (day/month/year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing (day/month/year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

(see note (d))

Yes

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	26
Claim(s)	2
Abstract	1
Drawing(s)	

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	One
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application

Signature: B-A-Yorke & Co

Date: **05 November 2002**

B.A. Yorke & Co.

12. Name and daytime telephone number of person to contact in the United Kingdom

Mrs. J. Crook
020 8560 5847

Warning

After an application for a patent has been filed. the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the united Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) Once you have filled in the form you must remember to sign and date it.

e) For details of the fee and ways to pay please contact the Patent Office.

TEL/ETV6–MEDIATED INHIBITION OF CELL PROLIFERATION

The invention relates to the field of cell proliferation, with applications in cancer diagnosis and therapy. The invention also relates to the screening of compounds for potential anti-cancer activity, whether prophylactic or therapeutic.

BACKGROUND OF THE INVENTION

In the more affluent countries of the world cancer is the cause of death of roughly one person in five. The American Cancer Society in 1993 reported that the five most common cancers are those of the lung, stomach, breast, colon/rectum and the uterine cervix. Cancer is not fatal in every case and only about half the number of people who develop cancer die of it. The problem facing cancer patients and their physicians is that seeking to cure cancer is like trying to get rid of weeds. Although cancer cells can be removed surgically or destroyed with toxic compounds or with radiation, it is very hard to eliminate all of the cancerous cells. A general goal is to find better ways of selectively killing cancer cells whilst leaving normal cells of the body unaffected. Part of that effort involves identifying new anti-cancer agents.

Cancer cells have lost the normal control of the cell cycle and so divide out of control compared to normal cells. The sub-cellular machinery which controls the cell cycle is a complex biochemical device made up of a set of interacting proteins that induce and co-ordinate the essential processes of duplication and division of the contents of a cell. In the normal cell cycle, the control system is regulated such that it can stop at specific points in the cycle. The stopping points allow for systems of feedback control from the processes of duplication or division. They also provide points for regulation by environmental signals.

The study of cancer cells has helped to show how growth factors regulate cell proliferation in normal cells through a complex network of intracellular signalling cascades. These cascades ultimately regulate gene transcription and the assembly and activation of the cell cycle control system. As knowledge increases about the component parts of the cell cycle control machinery and how it operates, the possibilities for correcting the loss of control in cancer cells are increased. Essential points of control and essential proteins can be identified in the control hierarchy and potentially targetted with drugs to act as activators or inhibitors, as required.

Signal transducer and activator of transcription 3 (Stat3) mediates the effect of many growth factors and cytokines. While several studies have described the possible role of Stat3 in oncogenesis (see for example, J. Bromberg, 2002, The Journal of Clinical Investigation, 109, 1139-1142; Levy and Lee, 2002, The Journal of Clinical Investigation, 109, 1143-1148), others have shown that Stat3 is in some instances a mediator of cytokine-induced inhibition of tumor cell proliferation (see for example, J. Behrmann, 1999, Oncogene, 18, 3742-53; S Akira, 1996, Proc Natl Acad Sci USA, 93, 3963-3966. Thus, the function of Stat3 in both normal and malignant cells still needs clarification.

The Tel ("translocation-ETS-leukemia", also known as ETV6) gene is a major target of translocations in leukaemia and its gene product has been described as a putative tumor suppressor in leukemias and some solid tumors. Expression of Tel in Ras-transformed NIH 3T3 cells inhibited cell growth in soft agar and in normal cultures (Fenrick et al., 2000, Molecular and Cellular Biology, 20, 5828-5839). Tel has also been shown to retard tumor formation in nude mice (Van Rompaey et al., 2000, 19, 5244-5250).

SUMMARY OF THE INVENTION

In accordance with a first aspect of the invention, a method of identifying an agent effective in modulating Stat3-dependent cell proliferation is provided, comprising i) incubating Tel/Etv6 with a compound; ii) detecting Tel/Etv6 activity; and iii) determining a compound-induced modulation in the Tel/Etv6 activity relative to when the compound is absent, wherein an alteration of the Tel/Etv6 activity in the presence of the compound is indicative of an agent effective in modulating Stat3- dependent cell proliferation.

The modulation can be inhibition of Tel/Etv6 activity, in which case the agent is effective in enhancing cytokine-induced inhibition of cell proliferation. Alternatively, the modulation is activation of Tel/Etv6 activity, in which case the agent is effective in inhibiting proliferation of cells expressing Stat 3, in particular phosphorylated Stat3. In the latter case, the cell proliferation can be independent of ras.

The methods are particularly useful in identifying agents effective in inhibiting cell proliferation of a melanoma or carcinoma.

Also provided are methods of inhibiting Stat3 expressing cancer cell proliferation, in particular melanomas or carcinomas, comprising contacting a cancer cell expressing Stat3, preferably phosphorylated Stat3, with an effective amount of an activator of Tel in an amount sufficient to inhibit Stat3 activity. Preferably, the cell proliferation is independent of ras.

In a further embodiment, the invention provides a method of inhibiting cytokine sensitive cancer cell growth, comprising contacting a cytokine-sensitive cancer cell with an effective amount of a Tel inhibitor in an amount sufficient to enhance Stat3 activity. The Tel inhibitor can be an RNAi or an antibody, for example.

DETAILED DESCRIPTION OF THE INVENTION

The present invention results from studies on the role of Stat3 in cell proliferation. The present inventors have evaluated the effect of an inducible Stat3 construct in a cytokine sensitive melanoma cell line and found that activation of Stat3 to moderate levels was sufficient to repress cell proliferation, by slowing down cell transit through the cell cycle (see Examples 1 and 2). Furthermore, enhanced and prolonged Stat3 activity led to cell cycle arrest and apoptosis.

Using oligonucleotide microarray analysis, the present inventors have further identified genes that have increased or decreased expression upon Stat3 activation (see Example 3). One such Stat3 target gene was found to be the transcription factor C/EBPdelta, which is one of the mediators of Stat3 inhibitory activity on cell proliferation, as is supported by targeted disruption of C/EBPdelta expression using small interfering (si) RNA (see Example 4). In contrast, inhibition of expression of another Stat3 target, the Tel/Etv6 transcription factor, increased Stat3 activity and further supporting the finding that Stat3 inhibits cell proliferation. Thus, Tel/Etv6 is an inhibitor of Stat3 activity and modulation of Tel/Etv6 allows regulation of the Stat3 signaling pathway (see Example 5).

Accordingly, the present invention provides a method of identifying an agent effective in reducing STAT3-dependent cell proliferation, based on the modulation of Tel/Etv6 levels or Tel/Etv6 activity. Typically such a method will comprise the steps of i) incubating Tel/Etv6 with a compound; ii) detecting the level of Tel/Etv6 or its activity; and iii) determining a compound-induced modulation in the level of Tel/Etv6 or its activity relative to when the compound is absent, wherein an alteration of the level of Tel/Etv6 or its activity in the presence of the compound is indicative of an agent effective in modulating Stat3-dependent cell proliferation.

The terms “TEL” and “Etv6” are used interchangeably herein and refer to ets variant gene 6 (TEL oncogene; NCBI accession number NM_001987; Golub, et

al., Cell 77 (2), 307-316, 1994). Exemplary functional equivalents or derivatives of TEL include molecules where TEL is covalently modified by substitution, chemical, enzymatic, or other appropriate means with a moiety other than a naturally occurring amino acid. Derivatives that retain common structural features can be fragments of TEL, in particular fragments maintaining transcription modulatory activity or isoform specific characteristics. Preferably, fragments will be between 50 and 350 amino acids in length. Derivatives of TEL also comprise mutants thereof, which may contain amino acid deletions, additions or substitutions, subject to the requirement to maintain at least one feature characteristic of TEL, preferably Stat 3 modulatory activity. Thus, conservative amino acid substitutions may be made substantially without altering the nature of TEL, as may truncations. Additions and substitutions may moreover be made to the fragments of TEL used in the screening methods of the invention, in particular those enhancing TEL catalytic activity or providing some other desirable property.

The screening assays of the invention are not limited to any particular method of determining the presence of Tel. The level of Tel can be determined by using an antibody specific for Tel, for example, in an immuno blot. Tel assays are also well known in the art (see for example Van Rompaey et al., 2000, Oncogene, 19, 5244-5250, which describes a method for assaying Tel transcriptional activity by determining Ras-expression or using DNA binding assays). Briefly, Tel will be incubated with a suitable nucleic acid substrate (comprising a Tel binding site), in a buffer allowing binding of Tel to the DNA. Direct binding can be measured using mobility shift assays or by detecting an effect on transcription of a target gene, such as ras or a target bioengineered gene, such as GFP or other detectable marker. Alternatively, antibodies specific for the products of TEL transcription modulatory activity can be used to detect activity. As will be apparent to those of ordinary skill in the art, the assays are easily amenable to high through-put technologies using robotics and automated processes. TEL

activity can also be assayed by detecting downstream targets of the protein. For example, TEL is known to affect transcription and translation of specific targets.

A compound-induced modulation of TEL activity or levels means that there is a change in TEL activity (or expression) in the presence of the compound relative to when the compound is absent. In particular a compound induced inhibition of TEL (or its activity) is reflected by a decrease in TEL activity relative to when the compound is absent. Conversely, a compound induced activation of TEL (or its activity) is reflected by an increase in TEL activity in the presence of the compound relative to when the compound is absent.

The modulation can therefore be inhibition of Tel/Etv6 activity, in which case the agent is effective in enhancing cytokine-induced inhibition of cell proliferation: Alternatively, the modulation can be activation of Tel/Etv6 activity, in which case the agent is effective in inhibiting proliferation of cells expressing Stat 3, in particular phosphorylated (activated) Stat3. In the latter case, the cell proliferation can be independent of ras.

The methods are particularly useful in identifying agents effective in inhibiting cell proliferation of a melanoma or carcinoma.

Activators and inhibitors are referred to collectively herein as modulators and preferably influence TEL activity directly. Assays carried out using reconstituted components can be easily designed to achieve direct TEL modulation (e.g., specific inhibition of TEL activity.

In accordance with a further aspect of the invention, a method is provided for screening an agent effective in STA3 dependent disorders, such as cell proliferation, by identifying compounds that modulate expression of a TEL gene or a gene expressed under the control of TEL regulatory sequences.

The methods comprise contacting transcriptionally active cellular components, preferably in a cell, with a nucleic acid encoding a TEL gene operably linked to a promoter sequence or a TEL promoter sequence (or other TEL regulatory regions allowing expression of the reporter gene) operably linked to a reporter gene in the presence of at least one compound; and detecting an effect of the compound on expression of the coding region, be it TEL expression or reporter gene expression. A decrease or an increase in TEL expression or promoter activity is indicative of an agent effective in inhibiting cell proliferation as as described above. Such assays can be cell-based assays, where the transcriptionally active cellular components and nucleic acid are present in a cell, although in vitro transcription assays are also well known in the art.

The reporter gene encodes any molecule capable of providing a detectable change. Such reporter molecules include fluorescent moieties (e.g., fluorescent proteins, such as, cyan fluorescent protein, CFP; yellow fluorescent protein, YFP; blue fluorescent protein, BFP; or green fluorescent protein, GFP; all available commercially, Clontech Living Colors User Manual, antigens, reporter enzymes and the like. Reporter enzymes include, but are not limited to, the following: beta-galactosidase, glucosidases, chloramphenicol acetyltransferase (CAT), glucoronidases, luciferase, peroxidases, phosphatases, oxidoreductases, dehydrogenases, transferases, isomerases, kinases, reductases, deaminases, catalases and urease. In selecting a reporter molecule to be used in the presently claimed method, the reporter molecule itself should not be inactivated by any putative agent or other component present in the screening assay, including inactivation by any protease activity present in the assay mixture. The selection of an appropriate reporter molecule will be readily apparent to those skilled in the art.

The nucleic acid will typically be provided in a vector allowing replication in one or more selected host cells, as is well known for a variety of bacteria, yeast, and mammalian cells. For example, various viral origins (SV40, polyoma, adenovirus,

VSV or BPV) are useful for cloning vectors in mammalian cells. The vector may, for example, be in the form of a plasmid, cosmid, viral particle, phage, or any other suitable vector or construct which can be taken up by a cell and used to express the sequence of interest or reporter gene.

Expression vectors usually contain a promoter operably linked to the protein-encoding nucleic acid sequence of interest, so as to direct mRNA synthesis. Promoters recognized by a variety of potential host cells are well known, as are TEL regulatory sequences and promoter sequences. "Operably linked" means joined as part of the same nucleic acid molecule, suitably positioned and oriented for transcription to be initiated from the promoter. DNA operably linked to a promoter is "under transcriptional control" of the promoter. Transcription from vectors in mammalian host cells is controlled, for example, by promoters obtained from the genomes of viruses such as polyoma virus, fowlpox virus, adenovirus (such as Adenovirus 2), bovine papilloma virus, avian sarcoma virus, cytomegalovirus, a retrovirus, hepatitis-B virus and Simian Virus 40 (SV40), from heterologous mammalian promoters, e.g. the actin promoter or an immunoglobulin promoter, and from heat-shock promoters, provided such promoters are compatible with the host cell systems. Expression vectors of the invention may also contain one or more selection genes, such as genes conferring resistance to antibiotics or other toxins.

The methods of the invention may therefore further include introducing the nucleic acid into a host cell. The introduction, which may (particularly for in vitro introduction) be generally referred to without limitation as “transformation”, may employ any available technique. For eukaryotic cells, suitable techniques may include calcium phosphate transfection, DEAE-Dextran, electroporation, liposome-mediated transfection and transduction using retrovirus or other virus, e.g. vaccini, as is well known in the art. See, for example, Keown et al., Methods in Enzymology, 185:527 537 (1990) and Mansour et al., Nature 336:348-352 (1988).

Host cells transfected or transformed with expression or cloning vectors described herein may be cultured in conventional nutrient media. The culture conditions, such as media, temperature, pH and the like, can be selected by the skilled artisan without undue experimentation. In general, principles, protocols, and practical techniques for maximizing the productivity of cell cultures can be found in "Mammalian Cell Biotechnology: a Practical Approach"; M. Butler, ed. JRL Press, (1991) and Sambrook et al, supra.

The invention further provides methods of identifying an agent effective in modulating Stat3-dependent cell proliferation administering a compound to a non-human animal model dependent on Tel activity and determining whether cell proliferation is affected relative to when the compound is absent. The non-human animals will typically be laboratory mammals such as mice or rats and various doses can be administered orally mixed with feed or by any other appropriate means, which may be chosen dependent on the properties of the compound, such as stability and targeted delivery. The Tel activity may be present as a gene in the laboratory animal, but may be from a different species, for example, the method may use a mouse comprising a human TEL gene, which replaces the mouse TEL gene, which will be particularly useful to determine the effects of agents on human TEL without using human subjects.

The screening systems are preferably used to screen compounds that may be present in small molecule libraries, peptide libraries, phage display libraries or natural product libraries. Compound may be inorganic or organic, for example, an antibiotic or antibody. For ease of administration, the compound is preferably a small molecule, which might bind to the DNA binding site or other regulatory site.

In order to potentially improve TEL modulators, isolated TEL can be used to establish secondary and tertiary structure of the whole protein or at least of the areas responsible for TEL activity. Conventional methods for the identification of

the 3-dimensional structure are, for example, X-ray studies or NMR studies. The data obtained with these or comparable methods may be used directly or indirectly for the identification or improvement of modulators of TEL, such as to provide specificity. A commonly used method in this respect is, for example, computer aided drug design or molecular modelling.

Kits useful for screening such compounds may also be prepared in accordance with the invention, and will comprise essentially TEL or a fragment thereof useful for screening, and instructions. Typically the TEL polypeptide will be provided together with means for detecting TEL activity and at least one compound (putative agent).

TEL for use in kits according to the invention may be provided in the form of a protein, for example in solution, suspension or lyophilised, or in the form of a nucleic acid sequence permitting the production of TEL or a fragment thereof in an expression system, optionally in situ.

Compounds according to the invention may be identified by screening using the techniques described hereinbefore, and prepared by extraction from natural or genetically modified sources according to established procedures, or by synthesis, especially in the case of low molecular weight chemical compounds. Proteinaceous compounds may be prepared by expression in recombinant expression systems, for example a baculovirus system, or in a bacterial system. Proteinaceous compounds are mainly useful for research into the function of signalling pathways, although they may have a therapeutic application, such as humanized inhibitory antibodies directed against TEL. Alternatively, nucleic acids, such as siRNA can be administered to inhibit TEL activity. SiRNA technology can be routinely applied based on sequences specific for TEL, such as those described below in the Examples. Targeted expression of siRNAs can be achieved using tissue-specific promoters.

Low molecular weight compounds, on the other hand, are preferably produced by chemical synthesis according to established procedures. They are primarily indicated as therapeutic agents. Low molecular weight compounds and organic compounds in general may be useful as agents for use in modulating Stat3-dependent cell proliferation.

Also provided are methods of inhibiting Stat3 expressing cancer cell proliferation, in particular melanomas or carcinomas, comprising contacting a cancer cell expressing Stat3, in particular phosphorylated Stat3, with an effective amount of an activator of Tel in an amount sufficient to inhibit Stat3 activity. Preferably, the cell proliferation is independent of ras.

In a further embodiment, the invention provides a method of inhibiting cytokine sensitive cancer cell growth, comprising contacting a cytokine-sensitive cancer cell with an effective amount of a Tel inhibitor in an amount sufficient to enhance Stat3 activity. The Tel inhibitor can be an RNAi or an antibody, for example.

Thus, also provided by the invention are compounds that directly modulate Tel for use in inhibiting STAT3-dependent cell proliferation. TEL modulators (e.g., inhibitors) may be formulated according to conventional methodology, depending on the exact nature of the modulator, and will typically comprise the modulator or a precursor thereof in association with a biologically acceptable carrier. In considering various therapies, it is understood that such therapies may be targeted to tissues demonstrated to express TEL and/or Stat3, in particular phosphorylated Stat3.

Delivery of the modulator to the affected cells and tissues can be accomplished using appropriate packaging or administration systems. For example, the modulator may be formulated for therapeutic use with agents acceptable for pharmaceutical administration and delivered to the subject by acceptable routes to produce a desired physiological effect. An effective amount is that amount that

produces the desired physiological effect, such as, a reduction in cell proliferation.

In a further aspect of the invention, the invention also provides a TEL modulator for the manufacture of a medicament for the treatment or prophylactic treatment of Stat3-dependent cell proliferation.

The invention also provides a method of diagnosing Stat3-dependent cancer, comprising detecting the level of Tel, in the sample and correlating a change in the amount of Tel or its activity in the sample when compared to a normal control value or range of values with a predisposition to Stat3-dependent cancer. The presence of Tel can be easily determined using antibodies or using activity assays as described above. For example, an increase in TEL of at least 20%, preferably at least 30% when compared to a normal control value or range of values is indicative of a predisposition to cytokine-dependent cancer. The sample may be any biopsy or body fluid.

Although the description above is primarily concerned with Tel/Etv6, it will be apparent to one of ordinary skill in the art in light of the present disclosure that any one of the genes/gene products referred to in Table 4 below can be modulated in the same way as Stat3 to inhibit cell proliferation. Therefore it would be well within the skill of the art to design screening assays and methods of inhibiting cell proliferation based on the teachings above relating to Tel/Etv6 but using the cell targets referred to in Table 4 instead of Tel/Etv 6. These genes can be appointed to various functional groups, such as transcriptional regulators mediating a Stat3-dependent response; receptors (e.g., the cytokine receptor, OSM receptor and cytokine receptor-like factor-1, which belong to the IL-6 type receptor family); intracellular signaling molecules; adhesion proteins (such as osteopontin) and genes involved in various aspect of cellular metabolism. For example, the expression of SOCS3, an inhibitor of Jak/Stat signaling, C/EBPdelta, JunB and alpha-antichymotrypsin (serpin A3) were significantly

increased upon 4HT treatment. Similarly, death-associated protein kinase 1 (DAPK1) and the serine protease inhibitor serpin B3 also increased upon 4HT treatment. Thus, for example, DAPK1 activity can be modulated to inhibit cell proliferation. Where it is desired to inhibit Stat3 activity (such as in phosphorylated Stat3-expressing cancers), this may be achieved by inhibiting DAPK activity (or one of the other gene products listed in Table 4). Similarly, where it is desired to enhance Stat3 activity (such as in cytokine sensitive cancers), the protease inhibitor serpin B3 may be administered.

The invention is further described, for the purposes of illustration only, in the following examples.

EXAMPLES

Methods of molecular genetics, protein and peptide biochemistry and immunology referred to but not explicitly described in this disclosure and examples are reported in the scientific literature and are well known to those skilled in the art. For example, standard methods in genetic engineering are carried out essentially as described in Sambrook et al., Molecular Cloning: A laboratory manual, 2nd Ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor NY, 1989.

Example 1: 4-hydroxytamoxifen induces Stat3ER DNA binding and transcriptional activity

Inhibition of breast carcinoma and melanoma cell proliferation by IL-6-type cytokines is dependent on Stat3. An inducible Stat3 construct was designed to allow the investigation of the role of Stat3 in the inhibition of cell proliferation, independently of other IL-6-induced signaling pathways. The inducible Stat3 construct comprises the entire coding sequence of Stat3 fused to a mutated

estrogen receptor ligand binding domain (ER-LBD) and is referred to herein as Stat3-ER. Addition of 4-hydroxytamoxifen (4HT), an ER-LBD ligand, triggers Stat3-ER dimerization, translocation to the nucleus and activation of Stat3-dependent transcriptional activity.

Briefly, a plasmid comprising the mutated ligand-binding domain of the murine estrogen receptor (T Littlewood, Nucleic Acids Res, 1995, 23,1686-90). ER™ was cloned into pcDNA 3.1 (commercially available from Invitrogen) as a BamH1-EcoR1 fragment. Stat3 sequence with an additional BamH1 site was obtained by PCR amplification of pRc/CMV Stat3 (J. Bromberg, Proc Natl Acad Sci U S A., 2001, 98, 1543-8.) and cloned into pcDNA3.1-ERTM.

IL-6 and oncostatin M (OSM) inhibit A375 melanoma cell proliferation. The Stat3-ER construct was transfected into the A375 melanoma cell line and several clones expressing high levels of Stat3-ER were selected. A375 melanoma cells were maintained in RPMI supplemented with 5% FCS (Life Technologies, Inc., Grand Island, NY). Plasmids were introduced into cells using Effectene transfection reagent (Qiagen, Hilden, Germany) according to the manufacturer's protocol. Cells were selected in 1 mg/ml G418, and several clones were picked, expanded in the presence of G418, and analyzed for STAT3-ER expression. Similar results were obtained with two independent STAT3-ER clones. (AER18 and AER2).

DNA binding assays were carried out using cells stimulated with 4HT (1 microM) for 0, 0.3, 1, 2, 4 and 24 hours. Nuclear extracts were prepared as described (Andrew and Faller, 1991). Stat3 Trans Cruz Oligonucleotide Agarose Conjugates (20 microliters; Santa Cruz Biotechnology, 5'- GAT CCT TCT GGG AAT TCC TAG ATC-3') were added to 80 microgrammes of nuclear extract in binding buffer (20 mM HEPES, 0.5 mM EDTA, 1 mM DTT, 2 microgrammes/ml poly dI-dC) for 2 hours at 4 °C with rotation. Samples were centrifuged and the pellet was washed two more times with binding buffer. Proteins were eluted from

beads by boiling in 25 microliters of 2x loading buffer (1 % DTT, 4 % SDS, 20 % Glycerol, 0.02 % Bromophenol Blue, 0.25 M TrisHCl 1M 6.8 pH) and SDS-PAGE was performed.

While low Stat3ER-DNA binding was detected as early as 20 min after stimulation, binding increased strongly after two hours of stimulation to reach a maximum measured level after 24hrs of 4HT stimulation. Thus, addition of 4HT to Stat3-ER-expressing A375 cells induced nuclear translocation and DNA-binding to a Stat3-specific oligonucleotide probe. The increase in DNA binding was accompanied by an increase in Stat3-ER expression, probably due to ligand-dependent stabilization of the Stat3-ER fusion protein.

Luciferase assays are used to verify that the Stat3-ER construct is transcriptionally active. For this purpose, a luciferase reporter gene driven by the acute-phase response element (APRE) of the alpha 2-macroglobulin gene, a target for Stat1 and Stat3 was used.

Cells (2 x 10^5cells in 6 well dish) were transfected with a reporter plasmid containing four copies of acute phase responsible element (APRE) in front of the minimal junB promoter linked to the luciferase gene (T Hirano, EMBO Journal, 1996, 15, 3651-3658), together with the internal control plasmid pRL-SV40 from Promega (Madison, WI). Twenty-four hours after the transfection, cells were either left unstimulated or stimulated with OSM (PeproTechEC, London, United Kingdom), 4-hydroxytamoxifen (4HT; Sigma, St. Louis, MO) or a combination of 4HT/OSM for 24 hours. The preparation of cell extracts and measurement of luciferase activities were carried out using the Dual-Luciferase reporter assay system from Promega (Madison, WI) in an Autolumat LB 953 (Berthold Technologies, Wildbad, Germany). Changes in firefly luciferase activity were expressed relative to Renilla luciferase activity in the same sample.

In A375 cells, oncostatin M (OSM) was the most potent activator of Stat3 transcriptional activity among the IL-6 family member we have tested, namely interleukin 6 (IL-6) and leukemia inhibitory factor (LIF). In Stat3-ER expressing A375 cells, 4HT stimulates transcription from the APRE, more efficiently than 100 ng/ml OSM. The results are presented in Table 1 below:

Table 1

Sample	*Relative Luciferase Activity*
Control	1
OSM (1 ng/ml)	3
OSM (10 ng/ml)	9
OSM (100 ng/ml)	18
4HT (1 microM)	29

We have determined 1 microM to be the optimal concentration of 4HT in this assay. Thus, Stat3-ER can be used effectively to establish the effects of Stat3 on cell proliferation.

Example 2: Stat3 activity inhibits A375 cell proliferation

In order to evaluate the role of Stat3 in A375 cell proliferation, A375-Stat3-ER cells were grown in the presence of OSM or 4HT and cell number determined over 3 days. At a concentration of 1 microM, 4HT does not affect proliferation of the parent A375 cells. Cells were grown in 35 mm-dishes and total cell number was determined at 0, 24, 48 and 72 hours after treatment with OSM and/or 4HT in a hemocytometer. The values are provided in Table 2 below.

Table 2

Number of Cells($x10^5$)

Time	Control	OSM	4HT	OSM + 4HT
0	0.8	0.8	0.8	0.8
24h	1.48	1.15	1.49	1.31
48h	4.33	2.58	3.60	2.25
72h	7.83	4.35	4.44	1.50

Upon 4HT treatment (1 microM) A375-Stat3-ER cell number was reduced by about 40 %, which is equivalent to the effect of 100 ng/ml OSM. Thus, Stat3 activity is not only required, but also sufficient to inhibit A375 melanoma cell proliferation. When combined, 4HT and OSM induced a marked decrease in A375-Stat3-ER cell number.

To further delineate the role of Stat3 activation in decreasing cell number, cell cycle analysis of A375-Stat3-ER cells was preformed, upon 4HT, OSM or combined 4HT/OSM treatment. In brief, cells were harvested at the indicated times (24, 48 and 72h) washed three times with ice-cold PBS and resuspended in propidium iodide buffer (1mM sodium citrate (pH 4.0), 1.5 mM NaCl, 5 mM EDTA, 5 mM EGTA, 0.1% NP40, 4 mg/ml propidium iodide and 80 mg/ml of RNase A). After 30 min incubation in the dark on ice, cell cycle distribution was measured with a Becton Dickinson FACS can flow cytometer. The results are shown in Table 3 below:

Table 3

Treatment/Time	G1	S	G2/M	Apoptotic cells
4HT 24h	+1%	-3%	+2%	<1%
4HT 48h	+5%	+1%	-6%	<1%
4HT 72h	-1%	0%	+1%	<1%
4HT+OSM 24h	+24 %	-21%	-3%	<1%
4HT+OSM 48h	+17%	-7%	-17%	8%

4HT+OSM 72h	-9%	-5%	-7%	21%

4HT only marginally affected cell cycle cell cycle profile, inducing a transient 5% increase in the percentage of cells in the G1 phase of the cell cycle after 48 h of treatment. Cell cycle was normal again after 3-days treatment, a time when cell number is decreased by about 40%. Likewise, OSM alone had little effect on the A375 cell cycle profile. In contrast, upon combined addition of 4HT and OSM, cells underwent a rapid (24 hrs) block in the G1 phase of the cell cycle. At 48 hrs, cells accumulated in G1 started to die from apoptosis as indicated by the appearance of a sub-G1 peak. The percentage of apoptotic cells reached 20 % after 3 days of stimulation. Thus, the reduction in cell number induced by the combined action of 4HT and OSM is largely due to cell death.

While cell distribution in the different phases of the cell cycle was not affected, the effect of Stat3 activation on cell cycle can be observed upon release of A375 Stat3-ER cells synchronized in G1. Entry of 4HT-treated cells into S phase was delayed relative to control cells. These results indicate that while not affecting cell cycle distribution, Stat3 activity delays progress through the cell cycle.

Example 3: Transcriptional Profiling of Stat3 genes

In order to understand Stat3's ability to affect cell proliferation and cell death, we have examined the profile of genes expressed upon Stat3 activation in A375 cells using oligonucleotide microarrays. Experiments were carried out on two independent clones, expressing similar amounts of Stat3-ER and showing a similar response in DNA binding, Stat3-driven reporter assay and inhibition of cell proliferation. DNA binding experiments and reporter assays indicated that Stat3 binding and transcriptional activity was strongly increased between 2 and 4 hrs after 4HT addition (see Example 1). This was confirmed by microarray experiments.

Briefly, microarray analysis was performed using HG U95A GeneChips™ (Affymetrix, Santa Clara, USA) essentially according to the manufacturer's instructions. Stat3-ER expressing cells were stimulated with 4HT for 4, 24 and 72 hrs before RNA collection. RNA from three independent experiments was pooled and and biotin-labeled cRNA probes were generated from each sample starting from 10 µg of total cellular RNA. The resulting biotinylated cRNAs were hybridized to the Affymetrix U95A oligonucleotide array containing more than 12,000 sequences and signals detected. Chip analysis was performed using the Affymetrix Microarray Suite v5 (target intensity 500 used for chip scaling) and GeneSpring 4.2.1 (Silicon Genetics). Changes in gene expression were assessed by looking for concordant changes between replicates using a signed Wilcoxon rank test (as recommended by Affymetrix). The "change" p-value threshold was < 0.003 for an increase in expression and > 0.997 for a decrease in expression. After concordance analysis these values become < 9 $x10^{-6}$ and > 0.999991 respectively. Any gene whose detection p-value was > 0.05 in all experimental conditions was discarded from the analysis as being unreliable data.

Genes that were significantly increased or decreased in both clones relative to untreated cells ($p<0.003$) were therefore identified, but only gene whose expression was changed more than two-fold were selected for further analysis. Genes that were significantly increased or decreased upon 4HT in non-transfected A375 cells, were excluded, unless the change in Stat3-ER expressing cells were more than double in both clones relative to the change in A375 cells.

Several known Stat3 target gene were induced in our system, validating our experimental approach (Table 4).

Table 4

4HT			OSM			
Clone 1	*Clone2*	*Avge*	*Clone1*	*Clone2*	*Avge*	*Description*
						Nuclear Proteins
3.6	6.3	4.9	1.4	1.0	1.2	v-jun avian sarcoma virus 17 oncogene homologue
5.6	3.7	4.6	3.9	1.6	2.7	CCAAT/enhancer binding protein (C/EBP), delta
5.6	3.1	4.3	1.8	1.1	1.5	v-jun avian sarcoma virus 17 oncogene homologue
3.9	4.5	4.2	3.9	4.0	3.9	Ets variant gene 6
3.6	4.1	3.9	2.9	4.6	3.7	v-fos FBJ murine osteosarcoma viral gene homologue
3.3	2.6	3.0	2.7	2.2	2.5	Jun B proto-oncogene
1.2	2.0	1.6	2.5	3.5	3.0	v-maf musculoaponeurotic fibrosarcoma oncogene homologue (avian)
						Intracellular signalling
9.3	11.7	10.5	4.5	10.2	7.4	Prostatic acid phosphatase precursor
9.2	10.5	9.9	11.6	9.7	10.7	STAT induced STAT inhibitor 3
6.9	3.7	5.3	3.7	2.1	2.9	Regulator of G protein signalling 16
5.7	4.8	5.3	3.5	6.9	5.2	Death-associated protein kinase 1
2.5	5.4	3.9	2.6	2.1	2.4	Insulin-like growth factor binding protein 3
2.3	3.9	3.1	2.4	1.7	2.0	Insulin-like growth factor binding protein 3
3.3	2.4	2.8	1.0	1.7	1.3	Prostatic acid phosphatase precursor
2.3	2.1	2.2	0.9	1.6	1.2	Tyrosine phosphatase/TIGR=HG620-HT620
						Growth Factors/cytokines/receptors
18.4	2.2	10.3	6.7	0.4	3.6	Killer cell lectin-like receptor subfamily C, member 3 isoform NKG2-E
12.9	4.4	8.6	5.2	0.7	2.9	osteoprotegrin
8.9	3.6	6.3	4.8	4.7	4.8	Brain-derived neurotrophic factor

9.5	2.7	6.1	4.3	1.0	2.7	Killer cell lectin-like receptor subfamily C, member 2
2.3	7.4	4.9	0.4	0.6	0.5	Interleukin 8
5.2	4.3	4.8	3.0	0.9	1.9	Cytokine receptor-like factor 1
2.8	5.2	4.0	1.3	2.9	2.1	Ephrin A1 precursor
4.3	2.4	3.3	1.9	2.1	2.0	Oncostatin M receptor
4.2	2.5	3.3	1.9	2.0	1.9	Oncostatin M receptor
2.9	2.2	2.6	1.2	0.7	0.9	Interleukin 8
2.8	2.0	2.4	0.9	1.5	1.2	Small inducible cytokine A2 (monocyte chemotactic protein 1)
						Cell metabolism/transporters/channels
5.2	8.3	6.7	2.8	4.6	3.7	Stanniocalcin 1
5.2	5.1	5.2	4.5	3.8	4.1	Aquaporin 3
5.7	3.2	4.4	9.2	6.7	8.0	Aquaporin 3
3.6	3.8	3.7	2.3	3.4	2.8	Cathepsin L
4.0	3.2	3.6	2.6	1.7	2.2	Kynureninase (L-kynurenine hydrolase)
4.3	2.4	3.3	1.8	1.3	1.5	Kynureninase (L-kynurenine hydrolase)
3.9	2.0	2.9	1.9	1.4	1.7	Kynureninase (L-kynurenine hydrolase)
2.9	2.3	2.6	1.9	2.6	2.3	Solute carrier family 2 (facilitated glucose transporter), member 3
2.7	2.5	2.6	2.8	1.9	2.4	Nicotinamide N-methyltransferase
1.8	1.6	1.7	2.5	2.5	2.5	Glycine dehydrogenase (decarboxylating, glycine decdarboxylase, glycine cleavage system protein P)
						Cell-cell interaction/cell adhesion
10.8	40.1	25.5	3.8	11.3	7.5	Secreted phosphoprotein 1 (osteopontin, bone sialoprotein 1, early T-lymphocyte activation 1)
16.9	20.0	18.4	3.5	5.7	4.6	Secreted phosphoprotein 1 (osteopontin, bone sialoprotein 1, early T-lymphocyte activation 1)

7.7	2.6	5.2	1.2	1.9	1.6	Fibronectin 1, isoform 1 preproprotein
6.8	3.3	5.0	0.6	2.3	1.5	Fibronectin 1, isoform 1 preproprotein
4.3	4.6	4.5	0.9	3.1	2.0	Fibronectin
3.1	2.5	2.8	2.2	0.6	1.4	Interferon induced transmembrane protein 1 (9-27)
2.8	2.1	2.4	1.7	2.1	1.9	Intercellular adhesion mo lecule 1 precursor
2.3	2.2	2.2	1.7	2.4	2.1	Niemann-Pick disease, type C1
						Inflammation/pathogen defense
3.8	2.0	2.9	2.5	2.2	2.3	I factor (complement)
3.0	2.4	2.7	3.4	2.6	3.0	MHC class II transactivator
2.7	2.3	2.5	3.1	2.4	2.8	Alpha-1-antichymotrypsin precursor
3.0	1.3	2.2	2.5	2.3	2.4	MHC, class II, DQ alpha 1 precursor
1.8	2.0	1.9	2.4	2.6	2.5	MHC, class II, DQ beta 1
						Other functions
103.0	97.5	100.2	28.8	26.7	27.8	Serine (or cysteine) protease inhibitor, clade B (ovalbumin), member 3
1.6	6.7	4.2	2.3	3.8	3.0	KIAA0500 protein
4.7	3.4	4.0	3.0	3.0	3.0	Regenerating islet-derived 1 alpha (pancreatic stone protein, pancreatic thread protein)
4.2	1.7	2.9	4.5	2.4	3.5	KIAA0303 protein
3.6	2.0	2.8	2.9	2.5	2.7	Major vault protein
2.6	2.0	2.3	1.5	1.6	1.5	H. sapiens mRNA; cDNA DZFZp586N012
2.5	2.4	2.4	1.5	1.7	1.6	KIAA0161 gene product
2.4	2.5	2.4	1.8	1.9	1.8	Ras-induced senescence 1
2.2	2.0	2.1	2.7	3.1	2.9	Absent in melanoma 2

For example, SOCS3, an inhibitor of Jak/Stat signaling, which is involved in the negative feedback of Stat signaling by interfering with Jak activity, was rapidly increased upon 4HT treatment (as early as 1 hr after treatment). Similarly, C/EBPdelta, JunB and alpha-antichymotrypsin (serpin A3) were significantly

increased upon 4HT treatment. However, other Stat3 target genes were also activated rapidly, and were therefore identified as novel Stat3 target genes. These include the Tel/Etv6 transcription factor, death-associated protein kinase 1 (DAPK1) and the serine protease inhibitor serpin B3.

Globally 4HT–induced Stat3 activation resulted in alteration of the expression of a limited number of genes. Indeed, after 24 hrs of treatment, 154 genes were significantly increased and 23 decreased, but only 39 genes were upregulated more than two-fold (Table 4). The sequences of the genes are well known in the art and are provided in various databases, such as Genbank. The genes can be appointed to various functional groups, such as transcriptional regulators mediating a Stat3-dependent response; receptors (e.g., the cytokine receptor, OSM receptor and cytokine receptor-like factor-1, which belong to the IL-6 type receptor family); intracellular signaling molecules; adhesion proteins (such as osteopontin) and genes involved in various aspect of cellular metabolism.

The results of the microarray screen for 4HT-induced genes in Stat3ER–expressing A375 cells were corroborated using a more physiological Stat3 activator, namely OSM. Because OSM activates multiple pathways besides Stat3 through gp130, such as MAPK, ribosomal S6 kinase or protein kinase C, we expected OSM-induced transcriptional profile to be broader, but to include 4HT targets. In Stat3-ER expressing cells, most 4HT targets were also OSM targets (Table 4). However, OSM induced a more moderate transcriptional response and therefore there were fewer genes increased above the two-fold threshold. Some genes including fibronectin, interleukin-8 and c-Jun appear not to be OSM targets. Conversely, a few genes appeared to be more efficiently induced by OSM than 4HT. Transcriptional activation of these genes, which includes members of the class II major histocompatibility complex, the putative tumor suppressor Aim2 and the proto-oncogene c-Maf may be dependent not only on activation of Stat3, but also on alternative pathways such as the MAPK or the PI3K pathway.

Example 4: Role of C/EBPdelta in Stat3-mediated inhibition of cell proliferation

Small interfering (si) RNAs are used to disrupt the expression of genes identified in Example 3 as playing a role in Stat3-induced inhibition of cell proliferation. This Example follows cell proliferation of Stat3-ER-expressing A375 cells treated with 4HT or a combination of 4HT and OSM, then cell proliferation in the absence or in the presence of siRNA to C/EBPd.

For siRNA transfection, cells were plated in six-well plates one day before transfection at a density of 5 x 10^4 cells/well. siRNA duplexes were introduced using the OligofectatAMINE reagent (Life Technologies) according to the manufacturer's protocol with 10 microliters of 20 microM siRNA and 3 microliters of transfection reagent/well. The following 21-mer oligoribonucleotide pairs were used:
C/EBPdelta siRNA nt 844-864, 5'-GCAGCUGCCCAGCCCGCCCdTdT-3' and 5'-GGGCGGGCUGGGCAGCUGdTdT-3';

The designed RNA oligonucleotides were 'blasted' against the GENBANK/EMBL databank to ensure gene specificity. The RNA oligonucleotides were obtained commercially. Transfection with expression vectors was carried out 1 day after the siRNA transfection using Effectene. When examined by quantitative PCR, C/EBPdelta mRNA was significantly increased upon 4HT treatment and strongly increased by the OSM/4HT combination, confirming the data obtained by microarray analysis. C/EBPdelta siRNA significantly reduced expression of C/EBPdelata. In the presence of C/EBPdelta siRNA, inhibition of A375 cell proliferation was significantly reduced (~ 40%, average of three independent experiments), indicating that C/EBPdelta is a mediator of Stat3 function.

Example 5: Tel is a negative regulator of Stat3 activity

This Example follows cell proliferation of Stat3-ER-expressing A375 cells treated with 4HT or a combination of 4HT and OSM, and in the absence or in the presence of siRNA to Tel. Experiments were performed to investigate the function of Tel in Stat3-mediated inhibition of cell proliferation essentially as described above but using TEL siRNA nt 540-560, 5'-CCCUCCCACCAUUGAACUGdTdT-3' and 5'-CAGUUCAAUGGUGGGAGGGdTdT-3'.

Protein analysis was carried out by Western blotting. In brief, cells were harvested in NP40 extraction buffer (50 mM Tris (pH 7.5), 1 mM EGTA, 5 mM EDTA, 120 mM NaCl, 1% NP40, 2 mM sodium orthovanadate, 50 mM sodium fluoride, 20 mM ß-glycerophosphate, 10 µg/ml leupeptin, 10 µg/ml aprotinin, and 0.5 mM phenylmethylsulfonyl fluoride) for 5 min on ice. The lysates were clarified by centrifugation and protein concentrations were determined using the Bio-Rad protein assay reagent (Bio-Rad Laboratories Gmbh, Munich, Germany). For immunoprecipitation, equal amounts of proteins were incubated with Stat3 (C-20) from Santa Cruz Biotechnology (Santa Cruz, CA) for 1 hr. Following SDS-polyacrylamide gel eletrophoresis (SDS-PAGE), proteins were blotted onto polyvinylidene difluoride membranes (Boehringer Mannheim, Mannheim, Germany). After blocking with 10% horse serum (Life Technologies, Inc.) in 50 mM Tris pH 7.5, 150 mM NaCl, 0.05% Tween 20, filters were probed with specific antibodies; c-Tel, Stat3 (C-20) from Santa Cruz Biotechnology (Santa Cruz, CA), phospho-Stat3 (Tyr 705) from Cell Signaling Technology (Beverly, MA). Proteins were visualized with peroxidase-coupled secondary antibodies using the enhanced chemiluminescence detection system (Amersham Pharmacia Biotech, Little Chalfont, United Kingdom).

Analysis at the protein level confirmed that Tel was strongly increased upon 4HT or 4HT/OSM treatment. This increase was largely prevented in the presence of Tel siRNA. Surprisingly, in the presence of Tel siRNA, Stat3-mediated inhibition

of A375 cell proliferation was significantly increased (from about 28% to about 40%. These results indicated that Tel acts as a Stat3-induced negative regulator of Stat3 activity.

To test whether inhibition of Tel expression was directly affecting Stat3 activity, Stat3-dependent transcriptional activity was assayed in Stat3-ER-expressing A375 in the absence or the presence of Tel siRNA using the luciferase assay described above. Stat3-dependent transcription of luciferase, induced by 4HT or OSM, was significantly increased (from about 6 to 16 fold increase over control, and from about 9 fold to 18 fold increase over control respectively) when Tel expression was reduced by siRNA.

Thus, the inhibition of breast carcinoma and melanoma cell proliferation by IL-6-type cytokines, as exemplified here with A375 cells, is dependent on Stat3 activity, which can be induced by reducing Tel activity.

All publication referred to herein are incorporated by reference as if each were referred to individually.

What is claimed is:

1. A method of identifying an agent effective in modulating Stat3-dependent cell proliferation, said method comprising the steps of:

   i) incubating Tel/Etv6 with a compound;

   ii) detecting Tel/Etv6 activity; and

   iii) determining a compound-induced modulation in the Tel/Etv6 activity relative to when said compound is absent, wherein an alteration of the Tel/Etv6 activity in the presence of the compound is indicative of an agent effective in modulating Stat3- dependent cell proliferation.

2. The method according to claim 1, wherein said modulation is inhibition of Tel/Etv6 activity and said agent is effective in enhancing cytokine-induced inhibition of cell proliferation.

3. The method according to claim 1, wherein said modulation is activation of Tel/Etv6 activity and said agent is effective in inhibiting proliferation of cells expressing Stat 3.

4. The method of claim 3, wherein said Stat3 is phosphorylated.

5. The method of claim 3 or 4, wherein said cell proliferation is independent of ras.

6. The method of any one of the preceding claims, wherein said cell proliferation is of a melanoma or carcinoma.

7. A method of inhibiting Stat3 expressing cancer cell proliferation, said method comprising contacting a cancer cell expressing Stat3 with an effective amount of an activator of Tel in an amount sufficient to inhibit Stat3 activity.

8. The method of claim 7, wherein said Stat3 is phosphorylated.

9. A method of inhibiting cytokine sensitive cancers, said method comprising contacting a cytokine-sensitive cancer cell with an effective amount of a Tel inhibitor in an amount sufficient to enhance Stat3 activity.

10. The method of claim 9, wherein said Tel inhibitor is an RNAi.

11. The method of claim 9, wherein said Tel inhibitor is an antibody.

ABSTRACT OF THE DISCLOSURE

TEL/ETV6–MEDIATED INHIBITION OF CELL PROLIFERATION

A method of modulating Stat3-dependent cell proliferation is provided, as well as screening methods for agents affecting Stat3-dependent cell proliferation. The method is exemplified by modulating Tel/Etv6.